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DECLARATION

I, Yukari Murata of AISIN ENGINEERING CO., LTD. having its place of business at 1-15, Hachiken cho, Kariya city, AICHI, Japan, do solemnly and sincerely declare that I understand the Japanese and English languages and that the attached document is a true and faithful translation made by me of the certified copy of a Japanese Patent Application No.2003-047344.

entitled:

Method of detecting a shift gate position and a shift gate position detecting apparatus of a vehicle transmission

Consisting of a Petition for Patent and the Specification.

Dated this 2nd day of July, 2007

Yukari. M

Yukari Murata

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[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Yoshihiro ICHIKAWA
[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Tatuhiro MIYAKE
[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Hiroyuki Nakadohzono
[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Takeshige MIYAZAKI
[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Mitsutoshi KAMIYA
[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Yoshiki ITOH
[INVENTOR]	
[ADDRESS OR RESIDENCE]	1, Shiroyama, Ojima-cho, Nishio-shi, Aichi-ken c/o Aisin AI Co., LTD.
[NAME]	Hideyuki YAMADA
[APPLICANT]	
[REGISTRATION NO.]	592058315
[NAME]	Aisin AI Co., LTD.
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[Document] Specification

[Title of the Invention] Method of detecting a shift gate position and a shift gate position detecting apparatus of a vehicle transmission

[Scope of Claims]

1. A method of determining a shift gate position for a vehicle transmission having: a base portion supporting an engaging portion; a shift gate defining a vehicle shift stage and engageable with and disengageable from the engaging portion, the shift gate having a stabilizing range for stabilizing an engagement degree with the engaging portion; a movable member engaging and disengaging the engaging portion and the shift gate in response to a movement; and an actuator moving the movable member in engaging and disengaging directions , the method of determining a shift gate position implementing:

a shift gate reference position determining process, by which the actuator is driven to bring the movable member to contact the other one and to stop the movable member, so that the stop position is determined as a shift gate reference position; and

after that, a shift gate position determining process, by which the actuator is driven to move the movable member having a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member, so that the engaging portion is stabilized within the stabilizing range of the shift gate and a position, where the engaging portion is stabilized, is determined as a position of the shift gate.

2. A method of determining a shift gate position for a vehicle transmission according to claim 1, wherein the shift gate is provided in a plural quantity, and the shift gate position determining process is implemented to each shift gate.

3. A method of determining a shift gate position for a vehicle transmission according to claim 1 or 2, wherein, in the shift gate position determining process, the movable member

is moved intermittently with a minute moving amount having a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member.

4. A shift gate position detecting apparatus for a vehicle transmission, comprising:

a base portion supporting an engaging portion;

a shift gate defining a vehicle shift stage and engageable with and disengageable from the engaging portion, the shift gate having a stabilizing range for stabilizing an engagement degree with the engaging portion;

a movable member engaging and disengaging the engaging portion and the shift gate in response to a movement;

an actuator moving the movable member in engaging and disengaging directions;

a shift gate reference position determining element, by which the actuator is driven to bring the movable member to contact the other one and to stop the movable member, so that the stop position is determined as a shift gate reference position; and

a shift gate position determining element by which the actuator is driven to move the movable member having a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member, so that the engaging portion is stabilized within the stabilizing range of the shift gate and a position, where the engaging portion is stabilized, is determined as a position of the shift gate.

5. A shift gate position detecting position for a vehicle transmission according to claim 4, wherein the shift gate position determining element moves the movable member intermittently with a minute moving amount having a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member.

6. A shift gate position detecting apparatus for a vehicle transmission according to claim 4 or 5, wherein the shift gate position determining element outputs a signal for stopping the actuator when the movable member moves and a signal for driving the actuator when the

movable member stops.

7. A shift gate position detecting apparatus for a vehicle transmission according to any of claims 3, 4, 5 and 6, wherein the stabilizing range of the shift gate is a V-shaped groove, and the engaging portion is engageable with and disengageable from the V-shaped groove.

[Detailed Description of Invention]

[0001]

[Field of the invention]

This invention generally relates to a method of determining a shift gate position of a vehicle transmission having a shift gate defining a vehicle shift stage. More particularly, this invention pertains to a shift gate position determining apparatus for a vehicle transmission.

[0002] [Prior art]

A conventional control device for a vehicle transmission has been known, which includes: a shift operation mechanism for performing a shift operation in the transmission; a select actuator for moving the shift operation mechanism in a selecting direction; a shift actuator for moving the shift operation mechanism in a shift direction, a target shift stage instruction means for instructing a target shift stage of the transmission; and a controller for controlling the select and shift actuators based upon a shift instruction from the target shift stage instruction means (Patent Document 1).

[0003] 【Patent Document 1】 TOKUKAI2002-147590

[0004]

【Object to be solved by the invention】

In the above-described control device, the select and shift actuators are controlled based upon the shift instruction from the target shift stage instruction means. Therefore, the shift operation can be automated even if the vehicle is provided with a manual type transmission.

[0005]

However, in order to automate the shift operation in the above-described vehicle transmission, it is necessary to obtain information on each shift gate position. However, the information on the shift gate position cannot be always accurate immediately after assembling the vehicle transmission. Further, even if a design dimension is referred to, the information on the shift gate position cannot be necessarily accurate due to some defects

such as fluctuations in dimensional tolerances for each product. Without highly precise information on the shift gate position, it is difficult or practically impossible to automate a shift operation.

[0006]

In the light of the forgoing, it is on object of the present invention to supply a method of determining a shift gate position of a vehicle transmission and a shift gate position detecting apparatus, which easily control an automatic shift operation and so on.

[0007]

【Means to solve the problems】

(1) A method of determining a shift gate position of a vehicle transmission according to the present invention includes a base portion supporting an engaging portion; a shift gate defining a vehicle shift stage and engageable with and disengageable from the engaging portion, the shift gate having a stabilizing range for stabilizing an engagement degree with the engaging portion; a movable member engaging and disengaging the engaging portion and the shift gate in response to a movement; and an actuator moving the movable member in engaging and disengaging directions. The method is characterized in implementing: a shift gate reference position determining process, by which the actuator is driven to bring the movable member to contact the other one and to stop the movable member, so that the stop position is determined as a shift gate reference position; and, after that, a shift gate position determining process, by which the actuator is driven to move the movable member having a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member, so that the engaging portion is stabilized within the stabilizing range of the shift gate and a position, where the engaging portion is stabilized, is determined as a position of the shift gate.

[0008]

In this case, the position of the movable member in engaging and disengaging directions is stabilized when the engaging portion is stabilized within the stabilizing range of the shift gate. This stabilized position is determined as a position of the shift gate. Therefore, the

position of the shift gate is determined with high precision.

[0009]

(2) A shift gate position detecting apparatus for a vehicle transmission is characterized in including: a base portion supporting an engaging portion; a shift gate defining a vehicle shift stage and engageable with and disengageable from the engaging portion, the shift gate having a stabilizing range for stabilizing an engagement degree with the engaging portion; a movable member engaging and disengaging the engaging portion and the shift gate in response to a movement; an actuator moving the movable member in engaging and disengaging directions; a shift gate reference position determining element, by which the actuator is driven to bring the movable member to contact the other one and to stop the movable member, so that the stop position is determined as a shift gate reference position; and a shift gate position determining element by which the actuator is driven to move the movable member having a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member, so that the engaging portion is stabilized within the stabilizing range of the shift gate and a position, where the engaging portion is stabilized, is determined as a position of the shift gate.

[0010]

In this case, the position of the movable member in engaging and disengaging directions is stabilized when the engaging portion is stabilized within the stabilizing range of the shift gate. This stabilized position is determined as a position of the shift gate. Therefore, the position of the shift gate is determined with high precision.

[0011]

[Embodiment of the present invention]

According to the method and apparatus of the present invention, the shift gate is provided in a plural quantity. In this case, the shift gate position determining process can be carried on for each shift gate. Therefore, the position of each shift gate is determined with high precision. The stage number of the shift gate can be the third, the fourth or the fifth. Sometimes, the stage number can be more than that. When there are plural shift gates

provided, a mode for determining a position of a shift gate can be employed in an order from a shift gate most nearest to the shift gate reference position. Accordingly, the position of the shift gate can be effectively determined with high precision.

[0012]

According to the method and the apparatus of the present invention, it is possible to employ a mode in which the movable member is moved intermittently with a minute moving amount having as a target that the engaging portion turns to within the stabilizing range of the shift gate of the movable member. Therefore, it is possible to move the movable member with a minute moving amount and to prevent an excessive moving amount of the movable member in engaging and disengaging directions. Therefore, it is possible to prevent the relative position of the engaging portion from crossing over the shift gate, which may occur due to an excessive moving amount of the movable member. Also from this point, it is possible to determine the position of the shift gate with high precision.

[0013]

According to the method and the apparatus of the present invention, in driving the actuator and moving the movable member, when the movable member moves, a signal for stopping the actuator is outputted. When the movable member stops, a signal for driving the actuator is outputted. Therefore, it is possible to move the movable member intermittently with a minute moving amount until the engaging portion is positioned at the stabilizing range of the shift gate, and it is possible to prevent an excessive moving amount of the movable member in engaging and disengaging directions. Therefore, it is possible to prevent the relative position of the engaging portion from crossing over the shift gate, which may occur due to an excessive moving amount of the movable member. Also from this point, it is possible to determine the position of the shift gate with high precision.

[0014]

According to the method and the apparatus of the present invention, the stabilizing range of the shift gate represents a portion stabilizing the movable member relative to the engaging portion. The stabilizing range of the shift gate can be formed with an inclined surface

having a V-shape for example formed at the movable member. The engaging portion can be exemplified by a shape that is engageable with, and disengageable from, the inclined surface of V-shaped for example. A ball-shaped member can represent such engaging portion. Even when the actuator is not driven, the V groove can draw the engaging portion and the movable member is stabilized in a stationary state.

[0015]

According to the method and the apparatus of the present invention, the actuator can be a conventional driving mechanism such as an electric actuator (such as an electric motor), a hydraulic actuator (such as an oil pressure cylinder, an oil pressure motor), a pneumatic actuator (such as a pneumatic cylinder, a pneumatic motor), or the like.

[0016]

(Embodiment)

Hereinafter, an embodiment of the present invention will be described in detail with reference to the attached drawing Figures. Fig. 1 is a system view of a vehicle control unit, Fig. 2 illustrates a gate mechanism, Fig. 3 illustrates an actuator mechanism, and Figs. 4, 5, 8 and 9 illustrate schematic conceptual diagrams. The embodiment is a case embedded into a manual transmission in which a shift operation is implemented by a driver's manual operation. According to the embodiment, a shift gate position determining apparatus includes: a vehicle driving power source 1 (an internal combustion engine or a motor) for driving a vehicle; a vehicle transmission 2 for changing a speed of a driving force of the vehicle driving power source 1 and transmitting to an wheel of the vehicle; a clutch 3 establishing and interrupting a power transmitting path for switching a gear of the vehicle transmission 2; an actuator 4 for operating the clutch 3; an ECU 6 having a CPU and a memory 6c; a select actuator 8 for performing a select operation of an actuator mechanism 7; a shift actuator 9 for performing a shift operation of the actuator mechanism 7. The shift gate position determining apparatus further includes: a shift sensor 11 for detecting a shift stage of a shift lever manually operated by a user upon shifting, a select stroke sensor 13 for detecting a stroke position of the actuator mechanism

7 in a select direction, a shift stroke sensor 14 for detecting a stroke position of the actuator mechanism 7 in a shift direction, a steering switch 15 mounted at a driver's seat to be operated by the driver upon shifting, a clutch sensor 16 for detecting a position, or a load, of the clutch 3, a vehicle speed sensor 17 for detecting a speed of the vehicle, an accelerator opening degree sensor 19 for detecting an accelerating opening degree of an acceleration element such as an accelerator pedal operated by a driver when accelerating; a throttle opening degree sensor 20 for detecting a throttle opening degree; and a rotational speed sensor 22 for detecting a rotational speed of an engine. A clutch pedal is not necessarily provided, and yet can be provided near the driver's seat.

[0017]

Each signal outputted from the shift sensor 11, the select stroke sensor 13, the shift stroke sensor 14, the steering switch 15, and the clutch sensor 16 is inputted to the ECU 6. Each signal outputted from the vehicle speed sensor 17, the accelerator opening degree sensor 19, the throttle opening degree sensor 20, and the rotational speed sensor 22 is first inputted to an engine ECU 25, and is then inputted to the ECU 6 via the engine ECU 25. The ECU 6 outputs a control signal to the select actuator 8, the shift actuator 9, and the clutch actuator 4 based upon the above-described signals. Therefore, it is possible to operate by a fully automatic system an automatic shifting system. The select actuator 8, the shift actuator 9, and the clutch actuator 4 can be an electric type motor, a hydraulic pressure type motor, and an air pressure type motor.

[0018]

Fig. 2 illustrates a gate mechanism 30 related to the actuator mechanism 7. As illustrated in Fig. 2, the gate mechanism 30 has gates arranged in the select direction. Each gate includes a shift position for defining a vehicle shift stage. More particularly, as illustrated in Fig. 2, the gate mechanism 30 is a three-gate type. The gate mechanism 30 includes a first shift gate 31, a second shift gate 32, and a third shift gate 33, all of which are arranged in parallel along the select direction. The first shift gate 31 defines a first shift stage (1^{st}) and a second shift stage (2^{nd}). The second shift gate 32 defines a third shift stage (3^{rd}) and

a fourth shift stage (4^{th}). The third shift gate 33 defines a fifth shift stage (5^{th}) and a reverse shift stage (Rev). In Fig. 2, the select direction is denoted with an arrow X, and the shift direction is denoted with an arrow Y.

[0019]

Fig. 3 illustrates a relevant portion of the actuator mechanism 7. The actuator mechanism 7 is supported by a housing 40 that is a portion of the transmission 2. The actuator mechanism 7 includes an engagement mechanism 41 supported by the housing 40 as a base portion, a groove set 50 movable to be engaged with or disengaged from the engagement mechanism 41, a movable member 46 called a shift and select shaft supporting the groove set 50, and the select actuator 8 for moving the movable member 46 in a longitudinal direction thereof, i.e., in the select direction which is denoted with the arrow X.

[0020]

As illustrated in Fig. 3, the engagement mechanism 41 includes a lock ball 42 functioning as an engaging portion, and a biasing spring 43 as a biasing element for biasing the lock ball 42 in a locking direction denoted with an arrow H. The groove set 50 includes a first groove 51, which is a recess corresponding to the first shift gate 31, a second groove 52, which is a recess corresponding to the second shift gate 32, and a third groove 53, which is a recess corresponding to the third shift gate 33.

[0021]

As illustrated in Fig. 2, each of the grooves 51, 52, and 53 has an inclined surface 54 exhibiting a V shape in a cross section, and a deepest portion 55 that is a bottom end of the V-shaped groove enhancing an engaging force against the lock ball 42.

[0022]

The inclined surface 54 for each of the grooves 51, 52, and 53 can function as a drawing range which automatically displaces the lock ball 42 towards the deepest portion 55 and draws the lock ball 42. In the drawing range, unless an external force is applied to the movable member 46, the movable member 46 moves in the arrow X direction so as to automatically position the lock ball 42 into the deepest portion 55 of the inclined surface 54.

Therefore, the drawing range defined by inclined surface 54 can function as a stabilizing range for stabilizing the position of the movable member 46. The deepest portion 55 can function as a most stabilizing portion for most stabilizing the position of the movable body 46 among the inclined surface 54.

[0023]

The deepest portion 55 of each of the grooves 51, 52, and 53 corresponds to each shift gate position. That is, as illustrated in Fig. 2, the deepest portion 55 of the first groove 51 corresponds to the position of the first shift gate 31, the deepest portion 55 of the second groove 52 corresponds to the position of the second shift gate 32, and the deepest portion 55 of the third groove 53 corresponds to the position of the third shift gate 33.

[0024]

In Fig. 3, a reference numeral 58 represents a shift fork. When the shift fork 58 moves in the shift direction, the movable member 46 rotates about an axis S2 of this by an activation of the shift actuator 9.

[0025]

As illustrated in Fig. 3, the select actuator 8 includes an electric motor 80 driven by the ECU 6, and a rotational shaft 82 rotated about an axis S1 and having a pinion gear 81. The movable member 46 is formed with a rack portion 47. When the electric motor 80 of the select actuator 8 is driven for rotation, the pinion gear 81 of the rotational shaft 82 is rotated, and the movable member 46 is moved back and forth in the direction denoted with the arrow X via the rack portion 47. Therefore, although the lock ball 42 is supported by the housing 40, the movable member 46 moves in the select direction denoted with the arrow X relative to the lock ball 42.

[0026]

Next, the following description will be given for describing detection of the positions of the first, second, and third shift gates 31, 32, and 33 according to the embodiment. Fig. 4 illustrates a state where the vehicle transmission is assembled, i.e., an initial position. According to the embodiment, the shift gate reference position determining process is

implemented from the initial position illustrated in Fig. 4. In this case, the movable member 46 is moved in a direction denoted with an arrow X2, i.e., in an impact direction, by activating the electric motor 80 of the select actuator 8 by the ECU 6. As a result, as illustrated in Fig. 5, a portion 46m of the movable member 46 comes in contact with a protruding impact portion 40f of the housing 40, wherein the movable member 46 is stopped in the arrow X (engaged and disengaged direction) direction. As described above, in a situation where the movable member 46 is stopped, a position of the movable member 46 with which the lock ball 42 is in contact is determined as a shift gate reference position PA (see Fig. 5).

[0027]

As illustrated in Fig. 5, the shift gate reference position PA is determined in a manner that the lock ball 42 exists at the side of the shift gate reference position PA outside of the drawing range of the first shift gate 31. Further, as illustrated in Figs. 4 and 5, a bearing 40s is provide at the housing 40 as the base portion, so that the movement of the movable member 46 is smooth.

[0028]After that, the ECU 6 activates the electric motor 80 of the select actuator 8 having a target that the lock ball 42 exists within the drawing range of the first shift gate 31 of the movable member 46. Here, the movable member 46 is moved in the arrow X1 direction (see Fig. 5). The arrow X1 direction is opposite to the direction in which the movable member 46 is moved to impact with the impact portion 40f of the housing 40.

[0029]

When the lock ball 42 is positioned within the drawing range of the first shift gate 31, the activation of the electric motor 80 is terminated. The movable member 46 is not hence applied with driving force from the electric motor 80 any more. Because the first shift gate 31 has the V-shaped cross section and the drawing range (stabilizing range), even if the electric motor 80 of the select actuator 8 is stopped, the movable member 46 moves so as to automatically position the lock ball 42 at the deepest portion 55 of the drawing range of the first shift gate 31. As a result, the center of the lock ball 42 is automatically

stabilized at the deepest portion 55 in the drawing range of the first shift gate 31 (see Fig. 6), and the movable member 46 is stabilized in a stationary state. The ECU 6 determines this stabilized position as a position P1 of the first shift gate 31 along the moving direction of the movable member 46.

[0030]

Fig. 7 explains a mode for moving the movable member 46 in a manner that the lock ball 42 is positioned within the drawing range of the first shift gate 31. A horizontal axis of Fig 7 represents a time, a vertical axis thereof represents driving force from the electric motor 80 of the select actuator 8 and a position of the movable member 46. As illustrated in Fig. 7, when the movable member 46 is positioned at the shift gate reference position PA, the ECU 6 applies a minute amount of driving force ΔD1 of driving force to the electric motor 80 of the select actuator 8 and moves the movable member 46 in the arrow X1 direction at a minute moving amount ΔL1. Even if driving force of the electric motor 80 of the select actuator 80 is to be zero at time t1 at which a movement of the movable member 46 is detected, the movable member 46 moves at a certain amount by an inertia force.

[0031]

At time t2 where a stop of the movable member 46 is detected, driving force is applied to the electric motor 80 of the select actuator 8 at a minute amount of driving force ΔD2 and the movable member 46 is moved in the arrow X1 direction at a minute moving amount ΔL2. At time t3 where the further movement of the movable member 46 is detected, the driving force of the electric motor 80 of the select actuator 8 is to be zero. Even if the driving force of the electric motor 80 of the select actuator 8 is to be zero, the movable member 46 moves at a certain amount by an inertia force. The electric motor 80 of the select actuator 8 is again applied with a minute amount of driving force ΔD3 at time t4 where a stop of the movable member 46 is detected, and the movable member 46 is moved

in the arrow X1 direction at a minute moving amount.

[0032]

As described above, until the lock ball 42 as the engaging portion is positioned at the drawing range of the first shift gate 31, the electric motor 80 of the select actuator 8 is intermittently driven, and the movable member 46 is moved intermittently with a minute moving amount. When the lock ball 42 is positioned at the drawing range of the first shift gate 31, the movable member 46 is moved so as to automatically draw the lock ball 42. Therefore, here, the electric motor 80 of the select actuator 8 is not driven. In this circumstance, when the lock ball 42 is positioned at the deepest portion 55 of the drawing range of the first shift gate 31, the movement of the movable member is stopped and stabilized.

[0033]

A further movement process is implemented after determining the position P1 of the first shift gate 31 as described above. That is, the ECU 6 activates the electric motor 80 of the select actuator 8 having a target that the lock ball 42 exists within the drawing range of the second shift gate 32 of the movable member 46. Here, the movable member 46 is moved in the arrow X1 direction. That is, in the same manner as the mode illustrated in Fig. 7, the ECU 6 applies intermittently a minute amount of driving force to the electric motor 80 of the select actuator 8 and intermittently moves the movable member 46 in the arrow X1 direction. When the lock ball 42 is positioned within the drawing range of the second shift gate 32, the electric motor 80 of the select actuator 8 is stopped. As a result, the lock ball 42 is automatically drawn to the deepest portion 55 of the drawing range of the second shift gate 32. Therefore, the lock ball 42 is stabilized at the deepest portion 55 of the drawing range of the second shift gate 32. That is, the movable member 46 is stabilized at that position in a stationary state. The stabilized position is determined as a position P2 of the second shift gate 32 in the moving direction (engaging and disengaging direction) of the movable member 46.

[0034]

A further movement process is implemented after determining the position P2 of the second shift gate 32 as described above. That is, the ECU 6 activates the electric motor 80 of the select actuator 8 having a target that the lock ball 42 exists within the drawing range of the third shift gate 33 of the movable member 46. Here, the movable member 46 is moved in the arrow X1 direction. That is, in the same manner as the mode illustrated in Fig. 7, the ECU 6 applies intermittently a minute amount of driving force to the electric motor 80 of the select actuator 8 and intermittently moves the movable member 46 in the arrow X1 direction. When the lock ball 42 is positioned within the drawing range of the third shift gate 33, the electric motor 80 of the select actuator 8 is stopped. As a result, the lock ball 42 is automatically drawn to the drawing range of the second shift gate 32. Therefore, the lock ball 42 is stabilized at the deepest portion 55 of the drawing range of the third shift gate 33. That is, the movable member 46 is stabilized at that position in a stationary state. The stabilized position is determined as a position P3 of the third shift gate 33 in the moving direction (engaging and disengaging direction) of the movable member 46.

[0035]

According to the embodiment of the present invention, the position P2 of the second shift gate 32 and the position P3 of the third shift gate 33 are determined in the same manner as the position P1 of the first shift gate 31, respectively. However, the present invention is not limited only to the above description, and the positions P2 and P3 can be determined in a different manner from the above description.

[0036]

For example, the followings are acceptable. That is, a temporary position P2' of the second shift gate 32 is calculated based upon a design dimensional value after determining the position P1 of the first shift gate 31. The temporary position P2' can be referred to as a target value. The electric motor 80 of the select actuator 8 is activated via a feedback control and so on in order to position the lock ball 42 at the target value. In this case, the movable member 46 is intermittently moved with a slight moving amount in the arrow X1 direction. If the lock ball 42 is not positioned in the drawing range of the second shift

gate 32, the ECU 6 again activates the electric motor 80 of the select actuator 8 moves the movable member at a slight moving amount in the arrow X1 direction, and stops the movable member 4. This operation is continued intermittently until the lock ball 42 is positioned within the drawing range of the second shift gate 32.

[0037]

When the electric motor 80 of the select actuator 8 is stopped when the lock ball 42 is positioned within the drawing range of the second shift gate 32, the lock ball 42 is drawn to the deepest portion 55 of the drawing range of the second shift gate 32, and the movable member 46 is automatically stabilized at the position (see Fig. 9). That is, the movable member 46 is stabilized in a stationary state. This stabilized position of the movable member 46 is determined as the position P2 of the second shift gate 32.

[0038]

That is, a temporary position P3' of the third shift gate 33 is calculated based upon a design dimensional value after determining the position P2 of the second shift gate 32. The temporary position P3' can be referred to as a target value. The electric motor 80 of the select actuator 8 is activated in order to position the lock ball 42 at the target value. In this case, the movable member 46 is intermittently moved with a slight moving amount in the arrow X1 direction and the movable member is stopped. If the lock ball 42 is not positioned in the drawing range of the third shift gate 33, the ECU 6 activates the electric motor 80 of the select actuator 8 and moves the movable member 46 at a slight moving amount in the arrow X1 direction, and stops the movable member 4. This operation is continued intermittently until the lock ball 42 is positioned within the drawing range of the third shift gate 33. When the electric motor 80 of the select actuator 8 is stopped when the lock ball 42 is positioned within the drawing range of the third shift gate 33, the lock ball 42 is drawn to the deepest portion 55 of the drawing range of the third shift gate 33 and is automatically stabilized. That is, the movable member 46 is stabilized in a stationary state. The ECU 6 determines the stabilized position as the position P3 of the third shift gate 33.

[0039]

As described above according to the embodiment, even when the position of the first shift gate 31, the position of the second shift gate 32, the position of the third shift gate 33, of the movable member 46 are not determined with high precision upon assembling the vehicle transmission, it is possible to determined with high precision the position P1 of the first shift gate 31, the position P2 of the second shift gate 32 and the position P3 of the third shift gate 33. Therefore, the automatic shift operation in the transmission can be effectively implemented by referring to the positions P1, P2, and P3. The above-described position determining process is implemented not only when assembling a vehicle transmission but also reassembling when parts are changed.

[0040]

(Flowchart)

Figs. 10, 11, 12 and 13 illustrate an example of a flowchart executing a process described above. The flowchart is not limited to the modes illustrated in Figs. 10, 11, 12 and 13 and can be changed appropriately within a scope of the subject matter. Fig. 10 is a main routine. In the main routine, the following steps are carried out in series: initial setting (step S100), a shift gate reference position determining process (step S200), a determining process of the position P1 of the first shift gate 31 (step S300), a determining process of the position P2 of the second shift gate 32 (step S400), a determining process of the position P3 of the third shift gate 33 (step S500) and the other processes (step S600).

[0041]

As described above, the determining process is implemented for determining the position from the position that is closer to the shift gate reference position PA, from among the shift gates 31, 32 and 33. Step S200 acts as a shift gate reference position-determining element because, in step S200, a process for determining a shift gate reference position is carried out. Step S300 acts as a shift gate position-determining element, because, in step S300, a process for determining a position of the first shift gate 31 is carried out. Step S400 acts as a shift gate position-determining element, because, in step S400, a process for determining a position of the second shift gate 32 is implemented. Step S500 acts as a

shift gate position-determining element, because in step S500, a process for determining a position of the third shift gate 33 is implemented.

[0042]

Fig. 11 is a flowchart of the above-described shift gate reference position determining process. As illustrated in Fig. 11, driving force is applied to the electric motor 80 of the select actuator 8 while the movable member 46 is positioned at the initial position as illustrated in Fig. 4 (step S202). The movable body 46 is moved along the arrow X2 direction from the initial position such that the movable body 46 impacts with the impacting portion 40f.The ECU 6 judges whether the movable member 46 is under a stationary condition (step S204). When the stop of the movable member 46 is not judged, the movable member 46 does not impact with the impacting portion 40f. Therefore, the driving force is continuously applied to the electric motor 80 of the select actuator 8 (step S202). In this case, as time goes on, the driving force applied to the electric motor 80 can be gradually increased.

[0043]

When the movable member 46 is stopped, the movable member 46 is in contact with the impacting portion 40f of the housing 40. As described above, when the movable member 46 is stopped, the position of the movable member 46 is determined as the shift gate reference position PA (step S206), and the shift gate reference position PA is stored in a predetermined memory area of the memory 6c.

[0044]

Fig. 12 is a flowchart of a shift gate position determining process for determining a position of the first shift gate 31, which position is nearest from the shift gate reference position PA. As illustrated in Fig. 12, the driving force applied to the electric motor 80 is controlled to zero, and further the ECVU 6 judges whether the lock ball 42 is in the drawing range of the first shift gate 31 of the movable member 46 (step S304). When the lock ball 42 exists outside the drawing range of the first shift gate 31, the program proceeds from step S304 to step S306, wherein the ECU 6 judges whether the lock ball 42 is at the side of the shift gate

reference position PA relative to the first shift gate 31. This judgment can be performed based upon a signal detected by the select stroke sensor 13.

[0045]

When the lock ball 42 exists outside the drawing range of the first shift gate 31 and at the side of the reference position, the program proceeds from step S306 to step S308, wherein the ECU 6 judges whether the movable member 46 is still moving so as to draw the lock ball 42 in a direction of the drawing range of the first shift gate 31. This judgment is also performed based upon the signal detected by the select stroke sensor 13.

[0046]

When an affirmative answer "Yes" is obtained at step S308, the movable member 46 is moving so as to automatically draw the lock ball 42 in a direction of the drawing range of the first shift gate 31. Therefore, the electric motor 80 does not have to be driven actively, and the driving force D of this time for the electric motor 80 of the select actuator 8 is controlled to zero (D=0) (step S310). Further, the driving force of this time (D=0) is outputted to the electric motor 80 of the select actuator 8 (step S304).

[0047]

As described above, according to the embodiment of the present invention, the electric motor 80 is not driven when the movable member 46 is moving in a manner that the lock ball 42 is automatically drawn in a direction of the drawing range of the first shift gate 31. Therefore, the lock ball 42 serving as the engaging portion can be effectively prevented from crossing over the drawing range (stabilizing range) of the first shift gate 31. Steps S308 and S310 act as an element for preventing the engaging portion from crossing over the stabilizing range.

[0048]

When a negative answer "No" is obtained at step S308 and the movable member 46 is not moving any more in a manner that the lock ball 42 is drawn in a direction of the drawing range of the first shift gate 31, it is necessary to actively drive the electric motor 80 of the select actuator 8. Therefore, in order to move the movable member 46 in a manner that

the lock ball 42 is automatically drawn in a direction of the drawing range of the first shift gate 31, a driving force at this time is calculated by adding α to the driving force of the last time (D=D+α) (step S312).

[0049]

The driving force of this time (D=D+α) is outputted to the electric motor 80 of the select actuator 8 (step S314), and the program returns to step S304. Therefore, the electric motor 80 of the select actuator 8 is driven at an amount corresponding to the driving force of this time. As a result, the electric motor 80 of the select actuator 8 is driven in a manner that the lock ball 42 is controlled in a direction to fall within the drawing range of the first shift gate 31.

[0050]

As described above, when the movable member 46 is not moving in a manner that the lock ball 42 is drawn in a direction of the drawing range of the first shift gate 31, the driving force applied to the electric motor 80 of the select actuator 8 is gradually increased through steps S308, S312 and S314. As a result, the lock ball 42 is surely drawn in a direction of the drawing range of the first shift gate 31.

[0051]

Therefore, steps S308, S312 and S314 act as a drawing accelerating element that actively operate the lock ball 42 to be drawn in a direction of the drawing range of the first shift gate 31.

[0052]

Returning back to step S306, when the lock ball 42 does not exist at the side of the shift gate reference position PA relative to the first shift gate 31, there is a high possibility that the lock ball 42 has crossed over the drawing range of the first shift gate 31. Therefore, in order to move the lock ball 42 to the drawing range of the first shift gate 31, the driving force of the electric motor 80 is controlled to be zero, and the movable member 46 is returned to the initial position (step S330). The program further returns to step S200 so as to start again from the shift gate reference position determining process.

[0053]

As a result of judgment at step S304, when the lock ball 42 is within the drawing range of the first shift gate 31, when the lock ball 42 is positioned at the deepest portion 55 of the first shift gate 31, the movable body 46 automatically stops at the position. Therefore, the electric motor 80 is not required to be activated by the ECU 6. The program hence proceeds to step S340 from S304, and driving force of the electric motor 80 of this time is calculated to be zero (D=0) so as stop driving the electric motor 80 of the select actuator 8. Further, the ECU 6 judges whether the movable member 46 is moving (step S342). When the movement of the movable member 46 is recognized, the program proceeds from step S342 to step S314, wherein the driving force of this time (D=0) is applied to the electric motor 80 and the program returns to step S304.

[0054]

When the lock ball 42 exists inside the drawing range of the first shift gate 31, steps S304 and S340 act as a movable member stopping element which automatically stops the movable member 46 at the position and prevents the lock ball 42 from crossing over the drawing range of the first shift gate 31.

[0055]

As a result of judgment at step S342, when the movement of the movable member 46 is not recognized, the lock ball 42 exists at the deepest portion 55 of the drawing range of the first shift gate 31. Therefore, this position is temporarily determined as a position P1 of the first shift gate 31 (Step S344). The ECU 6 judges whether a distance from the shift gate reference position PA to the position P3 of the first shift gate 31 is within a design range (step S346). As result of judgment at step S346, an affirmative answer "Yes" is obtained, the temporarily determined position P1 of the first shift gate 31 is normal. Therefore, the position P1 of the first shift gate 31 is actually determined (step S348) and the position is stored at a predetermined area of the memory 6c.

[0056]

As a result of judgment at step S346, when a negative answer "No" is obtained, the

program proceeds from step S346 to step S352. The movable member 46 is returned to the initial position. The program returns to step S200 and started again from the shift gate reference position determining process.

[0057]

Steps S342 and S344 act as a temporarily determining element for temporarily determining a position P1 of the first shift gate 31. Steps S346 and S348 act as an actually determining element for actually determining a position P1 of the first shift gate 31 when a distance between the shift gate reference position PA and the first shift gate 31 is within a designing range.

[0058]

As described above, after determining the position P1 of the first shift gate 31, which is nearest to the shift gate reference position PA, the position P2 of the second shift gate 32 is determined. The position P2 of the second shift gate 32 is close to the shift gate reference position PA following the position P1 of the first shift gate 31. As described above, a determining process for determining a position of the second shift gate 32 is implemented (step S400). After that, in order to determine a position of the third shift gate 33 which is next close to the shift gate reference position PA, a determining process for determining a position of the third shift gate 33 is implemented (step S500).

[0059]

According to the embodiment of the present invention, the determining process for determining a position P2 of the second shift gate 32 and the determining process for determining a position P3 of the third shift gate 33 are implemented in the same manner as the flowchart illustrated in Fig. 12. Alternatively, these are implemented by the flowchart illustrated in Fig. 13.

[0060]

Further explanation is added on the flowchart in Fig. 13. A position of a target shift gate (a temporary position P2' of the second shift gate 32) is temporarily calculated based upon a design dimensional value with reference to the position P1 of the first shift gate 31

determined as described above (step S402). The movable member 46 is a single assembly. Therefore, the dimensional value for each shift gate (first shift gate 31, second shift gate 32, third shift gate 33) is generally accurate. The ECU 6 judges whether the current position of the movable member 46 is within a range of the target shift gate (step S404). When a negative answer "No" is obtained at step S404, the electric motor 80 is activated by a feedback control and so on, so as to move the movable member 46 in the arrow X1 direction towards the position of the temporarily calculated target shift gate (step S406). Until the current position of the lock ball 42 reaches the range of the temporarily calculated target shift gate, the electric motor 80 of the select actuator 8 is activated so as to move the movable member 46 along the arrow X1 direction.

[0061]

As a result of judgment in step S404, when the current position is within the temporarily calculated target shift gate, the program proceeds from step S404 to step S410. The electric motor 80 of the select actuator 8 is stopped from being driven so as to stop the movable member 46 (step S410). The ECU 6 judges whether the movable member 46 is stopped (step S412). When the movable member 46 is stopped, the lock ball 42 is positioned at the deepest portion 55 of the target shift gate and the movable member 46 is stabilized in a stationary state. Therefore, the ECU 6 obtains and determines the position of the target shift gate (step S414), and the position is stored in a predetermined area of the memory 6c. In this case, when the target shift gate is the second shift gate 32, the same process is implemented having the third shift gate as a target shift gate.

[0062]

As described above, according to the flowcharts in Figs. 10 to 13, even when the position of the first shift gate 31, the position of the second shift gate 32, the position of the third shift gate 33, of the movable member 46 is not determined with high precision upon assembling or reassembling a vehicle transmission, the above operation enables determining the position P1 of the first shift gate 31, the position P2 of the second shift gate 32 and the position P3 of the third shift gate 33 with high precision. Therefore, it is

possible to appropriately execute an automatic shift operation of a vehicle transmission by employing these positions P1 to P3.

[0063]

(Others)

According to the above described embodiment, the number of shift gates is three but can be four or five. According to the embodiment, the position is determined in an order of the position P1 at the first shift gate 31, the position P2 at the second shift gate 32, and the position P3 at the third shift gate 33. However, these can be determined in an opposite order. Further, these can be determined in an order of the position P2 at the second shift gate 32, the position P1 at the first shift gate 31 and the position P3 at the third shift gate 33. The order can be another one. The present invention is not limited only to the above described embodiment and can be executed by appropriately being modified within the scope of the subject matter. The embodiment of the invention, the expressions in the embodiment and the expression in the flowcharts can be partially described in claims.

[0064]

[Effects of the invention]

According to the method and the apparatus of the present invention, even when the position of the shift gate of the movable member has not been determined with high precision, it is possible to determine the position of the shift gate with high precision. Therefore, it is possible to effectively perform an automatic shift operation of a vehicle transmission by employing these positions upon an automatic shift operation.

[Brief description of drawings]

【Fig. 1】 a system view of a vehicle control apparatus.

【Fig. 2】 a view illustrating a gate mechanism.

【Fig. 3】 a view illustrating an actuator mechanism.

【Fig. 4】 a view illustrating a state of a shift gate position immediately after being

assembled.

【Fig. 5】 a view illustrating a state in which a shift gate reference position is determined.

【Fig. 6】 a view illustrating a state in which a position of a first shift gate is determined.

【Fig. 7】 a graph for explaining a driving condition of a select actuator and a movement of a movable member during a shift gate position determining process and

【Fig. 8】 a structure for illustrating a distance from the position of the first shift gate to a position of a target shift gate (a second shift gate).

【Fig. 9】 a view illustrating a state in which a position of the second shift gate is determined.

【Fig. 10】 a flowchart illustrating a main routine.

【Fig. 11】 a flowchart for determining a shift gate reference position.

【Fig. 12】 a flowchart for determining a position of the first shift gate.

【Fig. 13】 a flowchart for determining a position of the second shift gate according to another control.

[Description of reference numerals]

1: vehicle driving power source, 2:vehicle transmission, 31: first shift gate, 32: second shift gate, 33: third shift gate, 6: ECU, 7: actuator mechanism, 8: select actuator (actuator), 80: electric motor, 9: shift actuator, 42: lock ball (engaging portion), 51: first V-shaped groove, 52: second V-shaped groove, 53: third V-shaped groove, 54: sliding surface (drawing range, stabilizing range), 55: deepest portion

[Abstract]

[Object]

to supply a method of determining a shift gate position and a shift gate position detecting apparatus, which each can obtain highly precise information on a position of a shift gate and can facilitate control of an automatic shift operation and so on.

[Means to solve]

A shift gate reference position determining process is implemented, by which the movable member 46 impacts an opponent 40f by driving the actuator so as to stop the movable member 46, and the stop position is determined as a shift gate reference position PA. After that, a shift gate position determining process is implemented, by which the movable member 46 is moved by driving the actuator having a target that the engaging portion 42 turns to within the stabilizing range 54 of the shift gate 31, 32, 33, the engaging portion 42 is stabilized within the stabilizing range 54 of the shift gate 31, 32, 33, so that the stabilized position is determined as a position of the shift gate.

[Selected Drawing] Fig. 5

F I G. 1

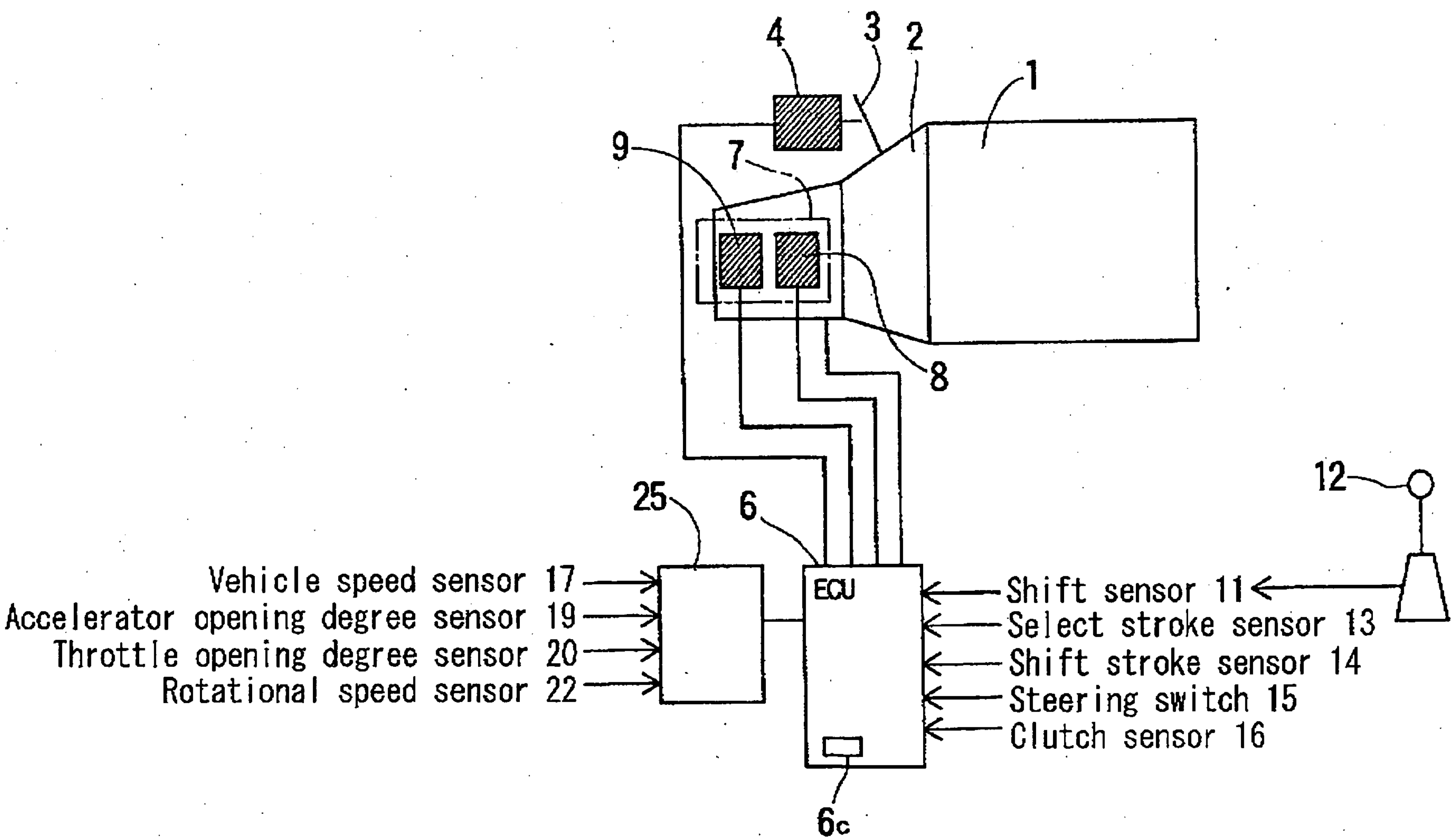

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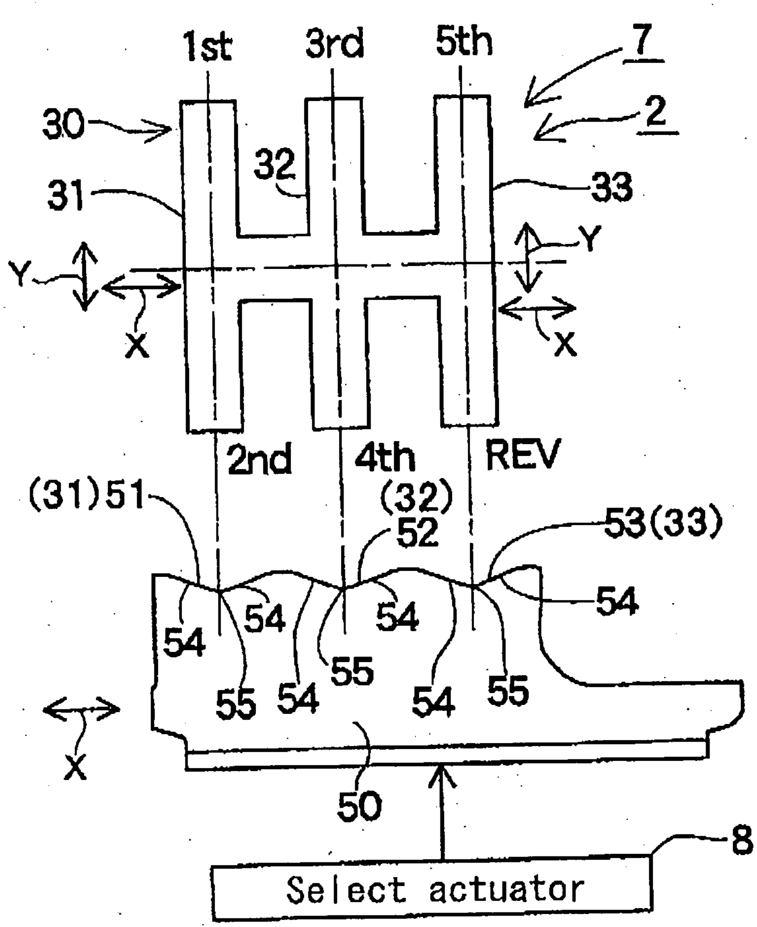
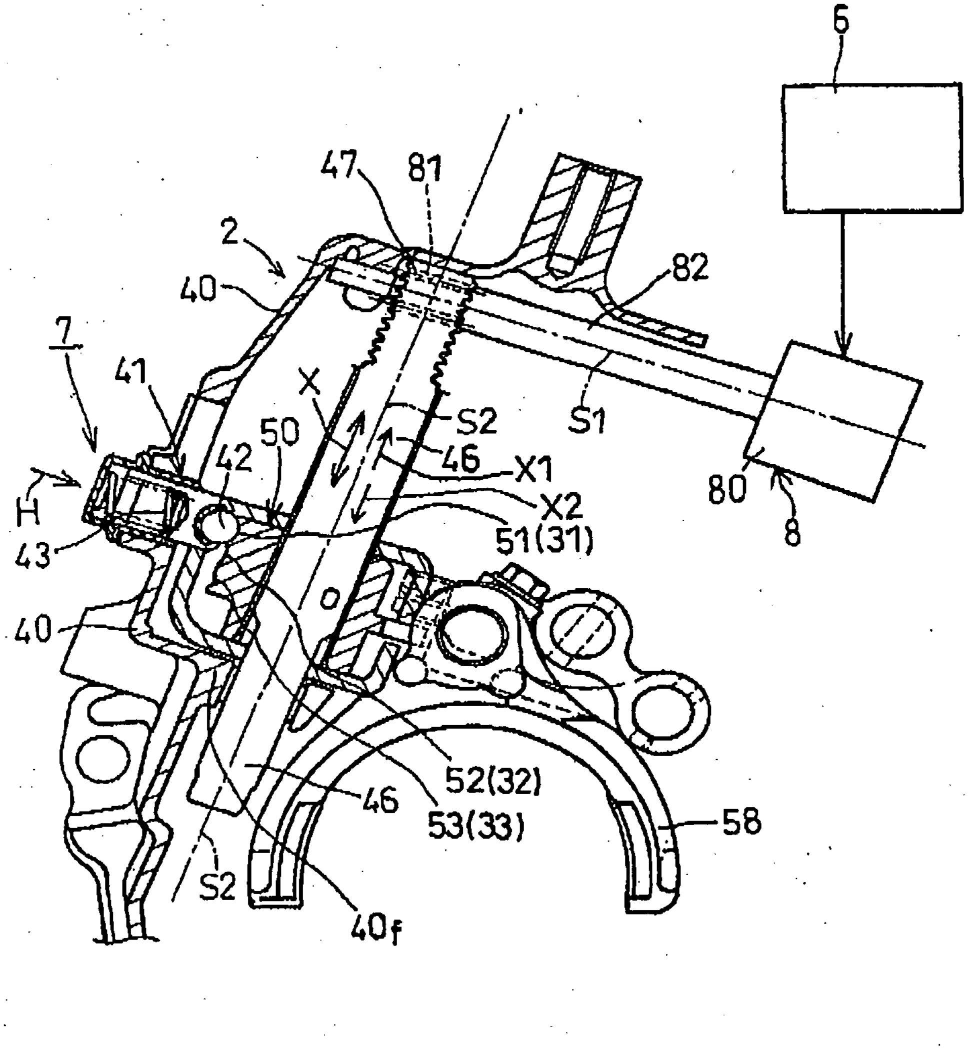
FIG. 2



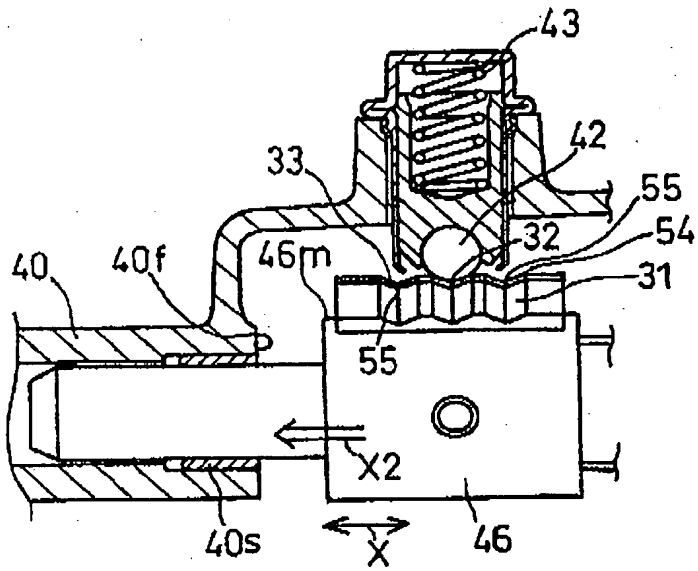
1st
3rd
5th
7
2
30
32
31
33
Y
Y
X
X
2nd
4th
REV
(31)51
(32)
52
53(33)
54
54
54
54
54
54
55
55
55
X
50
8
Select actuator

FIG. 3



6
47
81
2
82
40
7
41
X
S2
S1
50
42
46
X1
H
X2
80
43
51(31)
8
40
52(32)
46
53(33)
58
S2
40f

F I G. 4


43
42
33
55
32
54
46m
31
40
40f
55
X2
40s
X
46

F I G. 5

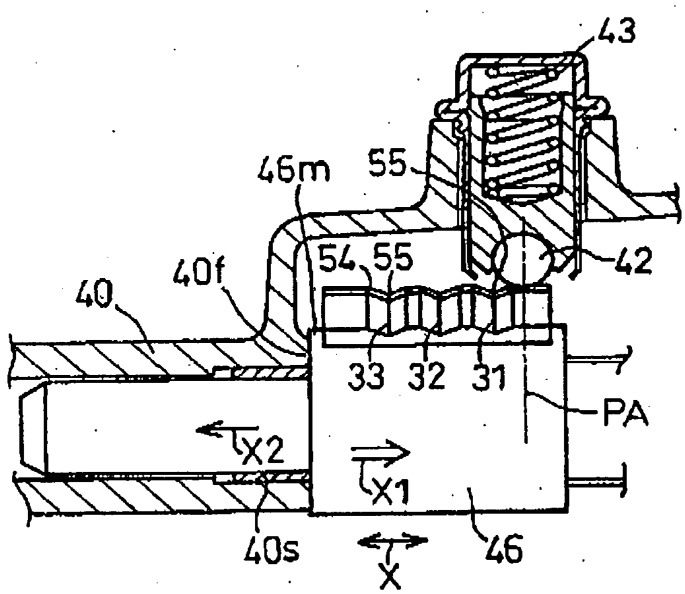

43
46m
55
54
55
42
40
40f
33
32
31
PA
X2
X1
40s
X
46

FIG. 6

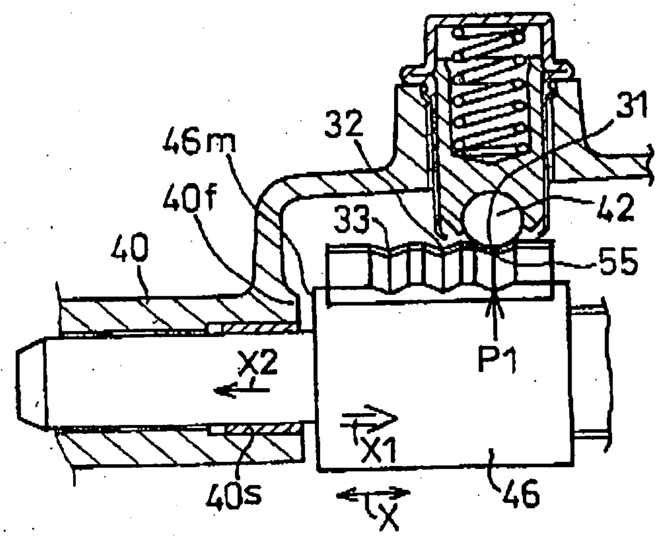

46m
32
31
40f
42
40
33
55
X2
P1
X1
40s
X
46

FIG. 7

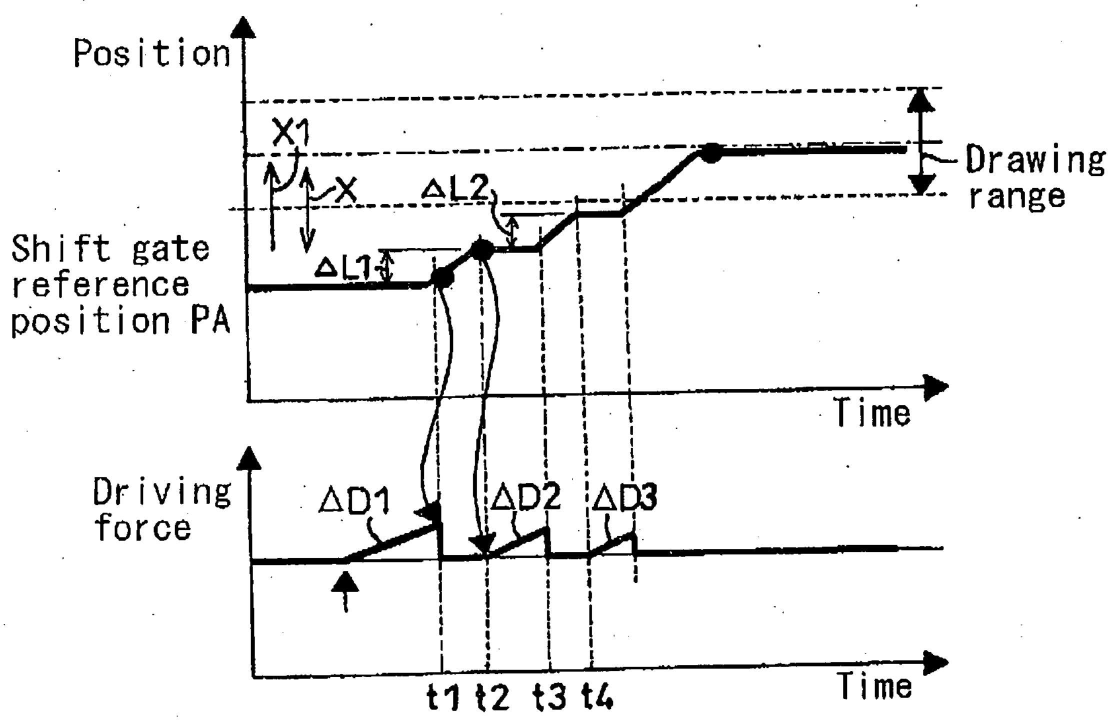

Position
X1
X
ΔL2
Drawing range
Shift gate reference position PA
ΔL1
Time
Driving force
ΔD1
ΔD2
ΔD3
t1 t2 t3 t4
Time

FIG. 8

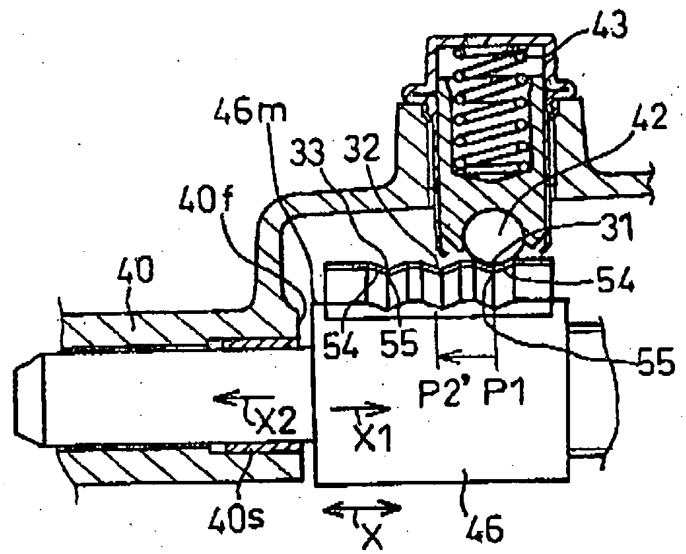

43
46m
33
32
42
40f
31
40
54
54
55
55
P2'
P1
X2
X1
40s
X
46

FIG. 9

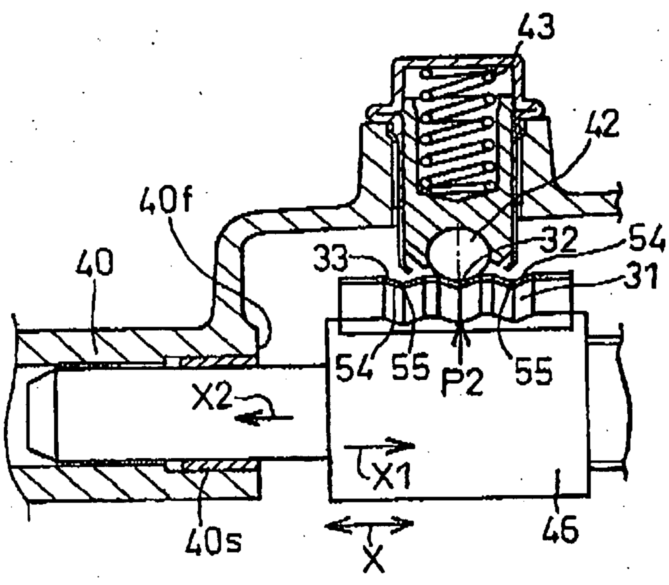

43
42
40f
32
54
33
40
31
54
55
P2
55
X2
X1
40s
X
46

FIG. 10

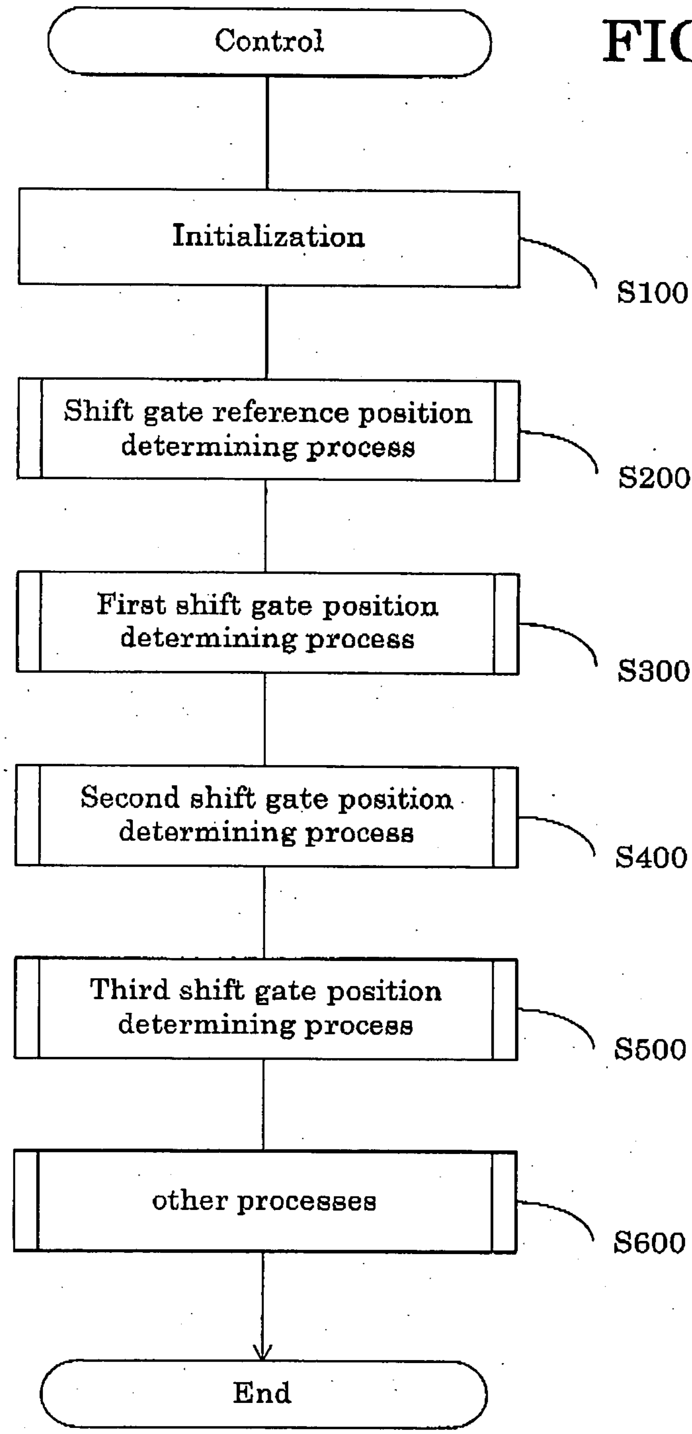
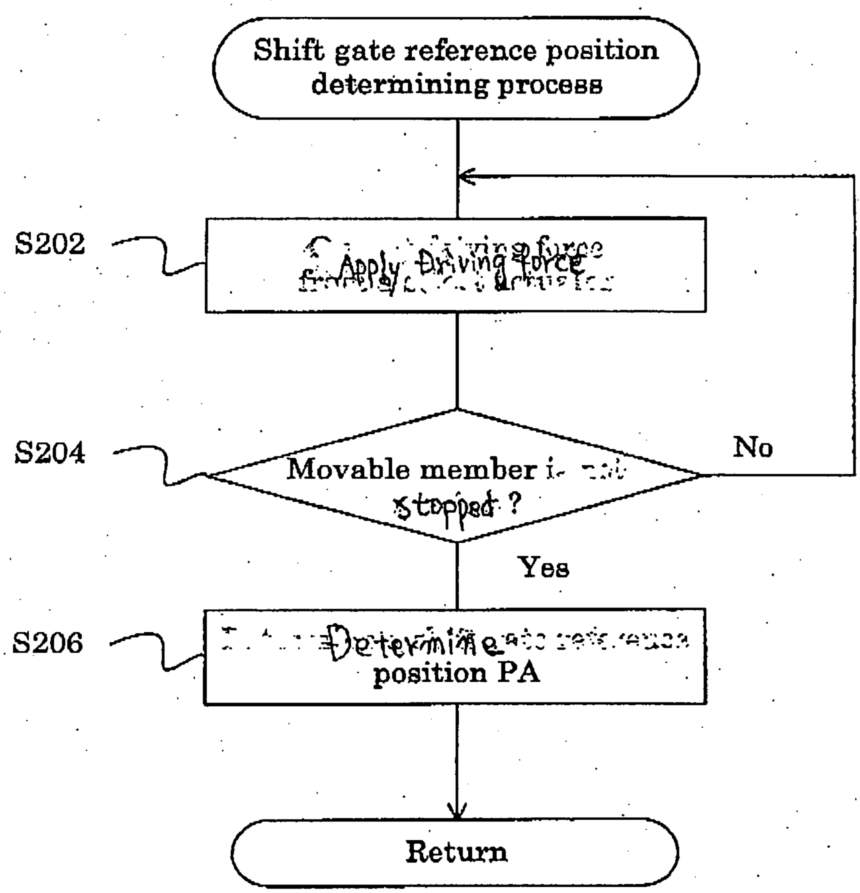
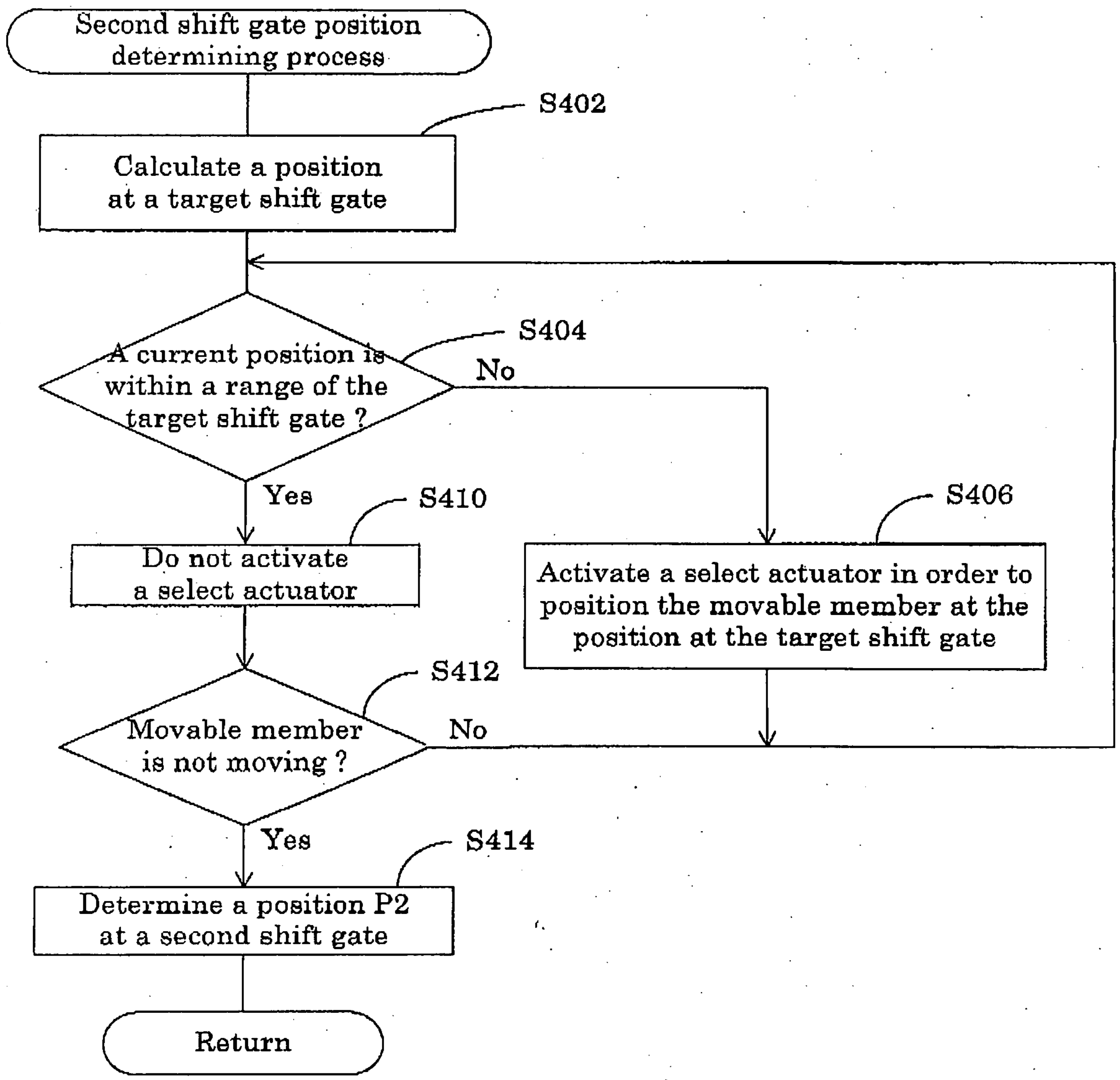

Control
Initialization
S100
Shift gate reference position determining process
S200
First shift gate position determining process
S300
Second shift gate position determining process
S400
Third shift gate position determining process
S500
other processes
S600
End

FIG. 11



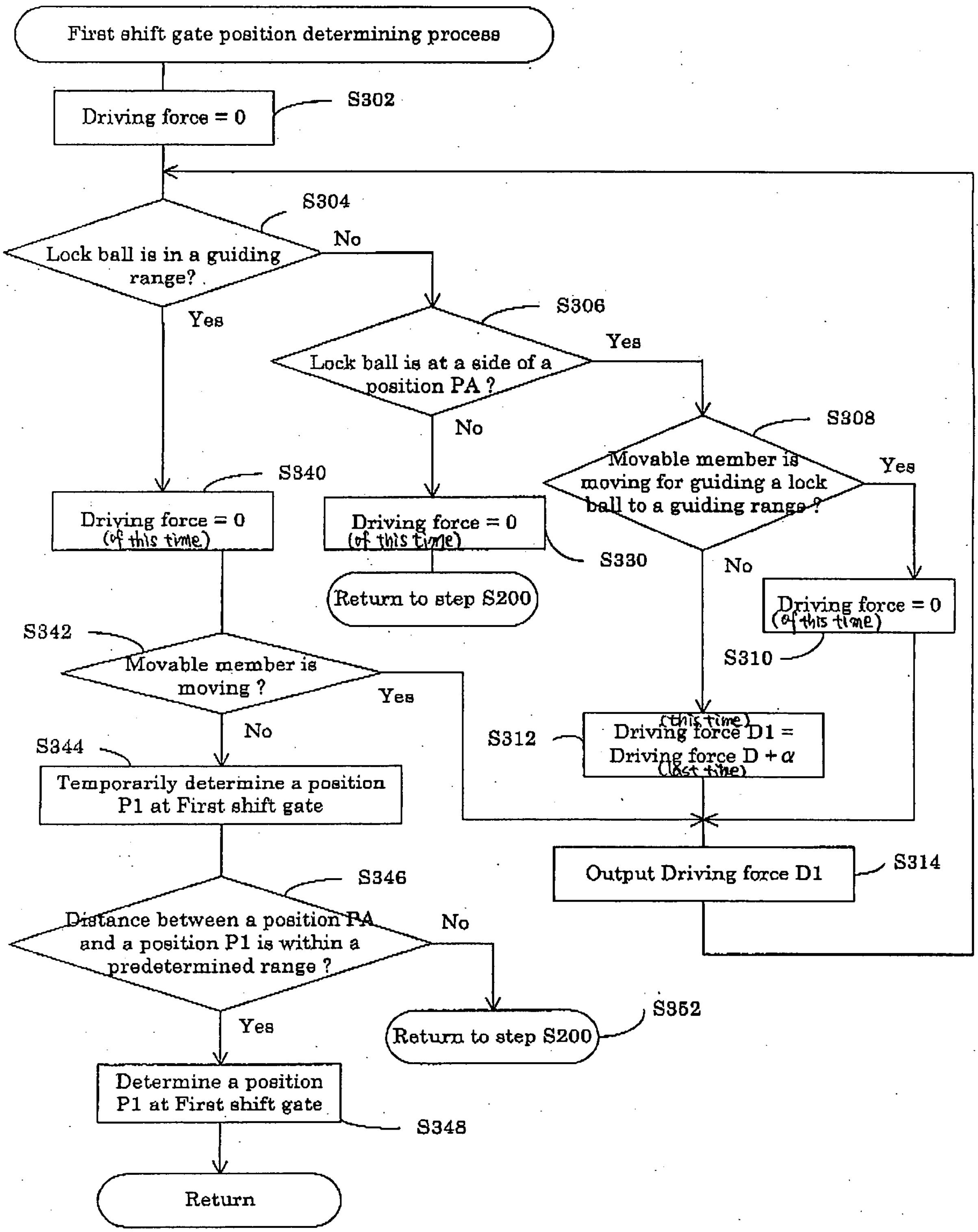
Shift gate reference position determining process
S202
Apply Driving force
S204
Movable member
stopped ?
No
Yes
S206
Determine
position PA
Return

FIG. 13



Second shift gate position determining process
S402
Calculate a position at a target shift gate
S404
A current position is within a range of the target shift gate ?
No
Yes
S410
Do not activate a select actuator
S406
Activate a select actuator in order to position the movable member at the position at the target shift gate
S412
Movable member is not moving ?
No
Yes
S414
Determine a position P2 at a second shift gate
Return

FIG. 12


First shift gate position determining process
Driving force = 0
S302
S304
Lock ball is in a guiding range?
No
Yes
S306
Lock ball is at a side of a position PA ?
Yes
No
S308
Movable member is moving for guiding a lock ball to a guiding range ?
Yes
No
S340
Driving force = 0 (of this time)
Driving force = 0 (of this time)
S330
Return to step S200
Driving force = 0 (of this time)
S310
S342
Movable member is moving ?
Yes
No
S312
Driving force D1 (this time) = Driving force D (last time) + α
S344
Temporarily determine a position P1 at First shift gate
Output Driving force D1
S314
S346
Distance between a position PA and a position P1 is within a predetermined range ?
No
Yes
Return to step S200
S352
Determine a position P1 at First shift gate
S348
Return